The opinion in support of the decision being entered today was <u>not</u> written for publication and is <u>not</u> binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte SCOTT J. TUMAN, DAVID L. SEIDEL and LEON LEVITT

Appeal No. 2005-1988
Application 09/822,651

ON BRIEF

Before OWENS, WALTZ, and FRANKLIN, *Administrative Patent Judges*.

FRANKLIN, *Administrative Patent Judge*.

DECISION ON APPEAL

This is a decision on appeal from the examiner's final rejection of claims 21-48 and 50-70. Claims 1-20 and 49 have been canceled.

Claims 21, 40, 48 and 56 are representative of the subject matter on appeal, and a copy of these claims is appended to this decision.

The examiner relies on the following references as evidence of unpatentability:

Allen et al. (Allen)	5,547,531	Aug. 20, 1996
Thomas	5,586,371	Dec. 24, 1996
Murasaki	5,643,651	Jul. 01, 1997
Wessels et al. (Wessels)	5,669,120	Sep. 23, 1997
Shepard et al. (Shepard)	6,205,623	Mar. 27, 2001 (filed Nov. 6, 1998)

Claims 21-31, 33-35, 37, 39, 40, 42-48, 50-53 and 55 stand rejected under 35 U.S.C. § 102(b), as being anticipated by Thomas. Claims 21-26, 28-31, 33, 39, 40, 42-48, 50-53, and 55 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Wessels.

Claims 32, 41 and 54 stand rejected under 35 U.S.C. § 103(a) as being obvious over Wessels in view Murasaki.

Claims 34-37, stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Wessels.

Claim 38 stands rejected under 35 U.S.C. § 103(a) as being obvious over Thomas in view of Shepard.

Claims 40, 42-48, 50-53, 55, and 56-70[1] stand rejected under 35 U.S.C. § 103(a) as being obvious over Wessels in view of Allen.

The rejection of claims 32, 41 and 54 under 35 U.S.C. § 103 as being obvious over Thomas in view of Murasaki has been withdrawn. Answer, page 6.

To the extent that appellants provide specific arguments regarding patentability, with respect to a particular claim, we consider such claim in this appeal. See 37 CFR § 41.37(c)(1)(vii)(September 2004); formerly 37 CFR

[1] We include claim 57 in this rejection because it depends upon claim 56. We note, however, that both appellants and the examiner did not list claim 57 in this rejection; yet, both appellants and the examiner state claim 57 is rejected (see Brief, page 2 and the

§ 1.192(c)(7)(2003). Also see Ex parte Schier, 21 USPQ2d 1016, 1018 (Bd. Pat. App. & Int. 1991).

OPINION

I. The rejection of claims 21-31, 33-35, 37, 39, 40, 42-48, 50-53 and 55 as being anticipated by Thomas

Beginning on page 5 of the brief, appellants argue the subject matter of claims 21, 40 and 48. Appellants argue that these claims recite "a plurality of discrete polymeric regions fused to a first major side of the web". Appellants also state that each of these claims further requires that "a plurality of stems extends from each discrete polymeric region of the plurality of polymeric regions".

Appellants argue that Thomas differs from these claims in that the identified portions of Thomas (of a loop 22 attached to a substrate 24 by a base 26) show that each "polymeric region" provides only a single loop. Brief, page 5. Appellants also argue that Thomas does not disclose any "stems" in the loop structure 22. Brief, page 6.

The examiner disagrees with the above position. The examiner states that "a row of adjacent loop components" shown in Thomas does form the claimed "discrete polymeric regions". Answer, page 10. The examiner also states that loop shanks 28 can be interpreted as "stems". Answer, pages 10.

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answer, page 2 (status of claims))

Hence, the issue before us is claim interpretation. We note that we interpret claims by giving the terms thereof the broadest reasonable interpretation in their ordinary usage as they would be understood by one of ordinary skill in the art in light of the written description in the specification, unless another meaning is intended by appellants as established in the written description of the specification, and without reading into the claims, any limitation or particular embodiment disclosed in the specification. See, e.g., In re Am. Acad. of Sci. Tech. Ctr., 367 F.3d 1359, 1364, 70 USPQ2d 1827, 1830 (Fed. Cir. 2004); In re Morris, 127 F.3d 1048, 1054-55, 44 USPQ2d 1023, 1027 (Fed. Cir. 1997); In re Zletz, 893 F.2d 319, 321-22, 13 USPQ2d 1320, 1322 (Fed. Cir. 1989).

With regard to the claimed phrase "a plurality of discrete polymeric regions", appellants' Figure 1 shows discrete polymeric regions 14. On page 4 of appellants' specification, the specification discloses that Figure 1 shows "a web 10 having stems 12 arranged in numerous patches or regions 14 on web surface 18". The examiner views each row of fused loops 22 (Figure 2 of Thomas) as a discrete polymeric region. We agree with the examiner's position. There is nothing in appellants' specification that specifically limits regions 14 to a particular arrangement of stems that occupy region 14. The examiner views the row of loop components 22 in Thomas as a region because there

is more than one row of loop components in Thomas, which is a plurality of discrete polymeric regions.

With regard to "a plurality of stems extending from each discrete polymeric region", appellants argue extensively that Thomas does not disclose "stems". In the reply brief, appellants argue that Thomas uses the term "stems" in connection with only hooks, and not loops. Reply brief, page 2.

Appellants' Figure 1 shows stems 12. The specification, on page 4, at line 19, discloses "web 10 having stems 12 arranged in numerous discrete patches or regions 14 on web surfaces 18." On page 4, line 21, the specification discloses "[t]he stems 12 are protrusions extending from web 10, and web 10 is a substrate that may be configured for the formation and holding of the stems 12."

In view of the above, appellants' specification indicates that the stems are protrusions extending from web 10. The issue therefore is whether Thomas discloses such a structure (protrusions extending from a web).

Upon our review of Thomas in this regard, Figure 2 of Thomas shows substrate 24 having loops 22. Figure 1 shows loops 22 having a base 26, and shank 28, and a distal end 30. This is further exemplified in Figure 3, and described in column 5, lines 5-16 of Thomas. Figure 3 shows a protrusion extending from substrate 24. This is the same structure as provided in appellants' specification. Hence, we agree with the examiner

that Thomas anticipates the claims in this regard.

Beginning on page 7 of the brief, appellants also argue that Thomas does not disclose that the discrete polymeric regions are "fused to a first major side" of the web.

Beginning on page 7 of appellants' specification, at line 22, it is disclosed that Figure 5 shows a web 50 being manufactured on an apparatus 51. The apparatus 51 is used to make stems 52 on the web 50. The stems 52 are arranged in discrete patches or regions 54. Apparatus 51 includes a source 53 of polymeric material. The source 53 preferably heats the polymeric material to a melting point, and then deposits the melted polymeric material on the web 50, as discrete portions 55. In the embodiment shown, source 53 includes an extruder that extrudes the polymeric material under pressure onto the web 50. The discrete portions 55 move along the web 50 until they come in contact with tool roll 56. Tool roll 56 has a continuous cylindrical tooled surface 57 containing a plurality of cavities configured to form the stems. These cavities are optionally evacuated by an external vacuum source. As the discrete portions 55 of polymeric material come in contact with surface 57 of the cylindrical tool roll 56, the portions 55 are simultaneously pressed into the cavities and fused to the web 50. See appellants' specification page 7, line 20 to page 8, line 3.

On page 8 of appellants' specification, beginning at line 4, the specification discloses that in the embodiment shown, a casting roll 58 provides pressure against the back side of the web 50 as the polymeric material cools, thereby assisting in pressing the polymeric material into the cavities in tooled surface 57 of tool roll 56, and fusing of the polymeric material to the web 50. The web 50 conforms to the tool roll 56 until release point 59 is reached, at which point the web 50 is pulled away from tooled surface 57 and the solidified polymeric material is stripped from the tool roll 56, exposing the newly formed stems 52. The bond between the substrate 50 and region 54 may be enhanced by adhesives, tie layers or surface treatment within the skill of the art.

In view of the above-discussed disclosure of appellants' specification, portions 55, that have been deposited by source 53, come into contact with surface 57, which presses portions 55 into the cavities, and fuses them to the web 50.

Hence, according to appellants' specification, the fusing of the polymeric material to web 50 involves application of pressure.

Thomas teaches that the array of loops 22 is produced by methods which yield free formed members 22A. The term "free formed" means a structure which is formed by a material deposited onto a substrate and which is not removed from a mold cavity or

extrusion dye in solid form or with a defined shape. The free formed members 22A are deposited onto a substrate 24 in a molten preferably liquid state and solidify, become fused with another adjacent free formed member 22A, or back upon itself, and upon cooling, becomes rigid. See column 5, lines 18-28 of Thomas.

Thomas further discloses that the free formed array of loops 22 is produced by a manufacturing process which is similar to a process commonly known as rotary screen printing. This process uses a depositing member in the form of a generally cylindrical screen, referred to as a print cylinder 60. Using this process, a substrate 24 having opposed surfaces is passed between the nip 58 of the print cylinder 60 and a backing roll 62, as illustrated in Figure 5 of Thomas. Figure 5 also shows backing roll 62 which positions substrate 24 against print cylinder 60. Liquid, thermally sensitive material is supplied from a heated source, such as a heated pressure bar 72. The thermally sensitive material is forced into the apertures 56. Thermally sensitive material is then extruded from the apertures 56 and to the substrate 24 in the desired pattern. See column 5, lines 28-58 of Thomas.

In view of the above disclosure found in Thomas, it is self-evident that fusing of the polymeric material to web 50, involving the application of pressure, occurs in Thomas because backing roll 62 reacts against the print cylinder 60. Hence, we

agree with the examiner's position on this issue.

On page 3 of the reply brief, appellants argue that Thomas does not specifically teach that the polymeric materials are fused at the substrate but rather teaches that only the bases of the loops or hooks are "deposited" on the substrate. We are not convinced by this argument in view of the aforementioned disclosure of appellants' specification as compared with the disclosure of Thomas.

Appellants do not provide an explanation as to how the pressure discussed on pages 5 through 8 of their specification differs from the pressure used in Thomas such that fusing does not occur in Thomas.

In view of the above, we affirm the 35 U.S.C. § 102(b) rejection of claims 21-31, 33-35, 37, 39, 40, 42-48, 50-53 and 55 as being anticipated by Thomas.

II. <u>The rejection of claims 21-26, 28-31, 33, 39, 40, 42-48, 50-53, and 55 as being anticipated by Wessels</u>

On page 10 of the brief, appellants argue that claims 21, 40, and 48 each recite "a plurality of discrete polymeric regions fused to a first major side of the web". Appellants also argue (again) that the claims recite "a plurality of stems extending from each discrete polymeric region of the plurality of polymeric regions".

Appellants argue that, in contrast, Wessels discloses a molded surface fastener wherein a synthetic resin encapsulates the substrate, and refers to figures 4A-4F of Wessels. Appellants argue that Wessels makes clear that the woven or knit cloth to be used "must have adequate pores for the passage of molten resin". Appellants conclude that the resin that forms the hooks in Wessels does so by encapsulating, i.e., flowing through, its base substrate, rather that fusing to a first major side, as recited by the claims.

As discussed supra, appellants' specification indicates that the word "fused" involves application of pressure to attach the polymeric material to web 50.

Wessels teaches that one typical manufacturing method is an extrusion molding method in which the die wheel having a multiplicity of engaging-element-forming cavities and annular recesses and a press roller confronting the die wheel with a predetermined gap are rotated in opposite directions. Simultaneously, molten resin is continuously extruded from an extrusion nozzle to the gap between the die wheel and the press roller by a predetermined width and, at the same time, the coarse pile woven or knit cloth is continuously introduced between the die wheel and the molten resin extruded from the corrosion nozzle. The molten resin forms the substrate sheet in the gap by the **pressing force** [emphasis added] of the press roller and, at

the same time, part of the molten resin reaches the circumferential surface of the die wheel through the pores of the pile woven or knit cloth to embed the pile woven or knit cloth in the molten resin and to fill the hook-element-forming cavities to form hook elements. See column 4, lines 26-48.

In view of the above disclosure of Wessels, it is clear that one embodiment teaches the use of pressure (pressing force) in attaching the molten resin to the pile woven or knit cloth. Hence, we agree with the examiner's position on this issue. Appellants have not explained how this pressing force is different such that the polymeric material of Wessels would not be fused to a first major side of the web.

On page 11 of the brief, appellants argue that "fused to first major side of the web" cannot include encapsulation of the entire web as asserted by the examiner. We are not convinced by this argument. Whether or not the molten resin of Wessels is fused to a first side, as well as a second side, still provides that the molten resin is fused to a first major side of the web. As such, we agree with the examiner's statement made at the bottom of page 10 and at the top of page 11 of the answer in this regard.

In view of the above, we affirm the rejection of claims 21, 40 and 48.

With respect to claims 23, 42-48, 50-53, and 55, beginning on page 12 of the brief, appellants argue that these claims teach the use of an elastic web. Appellants argue that, in contrast, Wessels does not teach the use of an elastic web.[2]

On page 6 of the answer, the examiner's position is that Figure 4A of Wessels shows a pile core sheet of a coarse woven or knit cloth, and the pile surface acquires greater flexibility. See column 6, lines 32-39 of Wessels.

According to appellants' specification, on page 2, the specification states that the web may include at least one elastic material. The specification gives examples of elastic materials (see lines 22-24, on page 2 of the specification). The dictionary definition for "elastic", as provided at http://www.answers.com/topic/elastic, is:

adj.

1.
   a. Easily resuming original shape after being stretched or expanded; flexible. See synonyms at flexible.
   b. Springy; rebounding.
2. *Physics.* Returning to or capable of returning to an initial form or state after deformation.

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[2] We first note that claims 42-48 do not recite an elastic web; however these claims depend upon claim 40 which does recite an elastic web. Claims 50-53 do not recite an elastic web. However, these claims depend upon claim 48, which does recite an elastic web. Claim 55 also depends upon claim 48. Hence, appellants have overlooked the fact that only claims 23 and 48 (from the group of claims 23, 42-48, 50-53, and 55), specifically recite an elastic web. We therefore limit our consideration to claims 23 and 48, in connection with this group of claims.

3. Quick to recover, as from disappointment: *an elastic spirit.*

4. Capable of adapting to change or a variety of circumstances.

n.

1.

   a. A flexible stretchable fabric made with interwoven strands of rubber or an imitative synthetic fiber.

   b. An object made of this fabric.

2. A rubber band.

The issue is whether Wessels uses an elastic material for the web.

Upon our review of Wessels in this regard, we find that pile core sheet S is made of a thermoplastic resin. See column 6, lines 6-55 of Wessels. Particularly, the types of thermoplastic resin are "nylon, polyester and polypropylene". See column 6, lines 40-41. Nylon and polypropylene are known for their elasticity.[3] Hence, we agree with the examiner's position that Wessels teaches that the web is an elastic material.

In view of the above, we affirm the 35 U.S.C. § 102(b) rejection of claims 21-26, 28-31, 33, 39, 40, 42-48, 50-53, and 55 as being as being anticipated by Wessels.

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[3] See the attached article provided herewith entitled *"Design Tools, Design Guide"*. On page 2 of this article, it is taught that materials such as polyethylene, vinyl, polypropylene, or nylon have elastic properties.

III. The 35 U.S.C. § 103 rejection of claim 38 as obvious over Thomas in view of Shepard

Beginning on page 16 of the brief, appellants argue that claim 38 is not prima facie obvious over Thomas in view of Shepard. Appellants again repeat the arguments presented with respect to the Thomas reference (the argument that Thomas does not teach (1) a plurality of stems extending from each discrete polymeric region, (2) polymeric regions fused to a first major side of the web, and (3) fusing of the polymeric material to the web). However, we are not convinced by such argument for the reasons discussed, supra, regarding these limitations.

On page 17 of the brief, appellants also argue that the teachings of Thomas are directed to the manufacture of hooks or loops by severing strands of polymer under tension such that the severed strands recoil to form loops.

Appellants argue that a proper prima facie case of obviousness would require that the examiner identify or discuss how one of ordinary skill in the art would have modified the teachings of Thomas to provide mushroom shaped fasteners, as recited in claim 38.

Appellants also argue that Shepard does not teach or suggest the formation of a "mushroom head" on a loop. Appellants argue

that such actions are limited to stems or hooks, not loops.[4]

On page 7 of the answer, it is the examiner's position that Shepard teaches that hook-shaped fastener elements are functionally equivalent to mushroom head shaped fastener elements for releasably engaging a loop material, and refers to column 2, lines 22-24 and column 6,lines 46-47 of Shepard. The examiner's position is that it would have been obvious to have used mushroom head shaped fastener elements in Thomas instead of hook-shaped fastener elements because Shepard teaches that the hook-shaped fastening elements are functionally equivalent to mushroom head-shaped fastener elements for releasably engaging a loop material.

Claim 38 requires that each stem, as set forth in claim 21, comprises a mushroom head. As taught by Shepard, hook and loop fasteners include a loop component and a hook component. The fastener elements of the hook component may be hook or mushroom shaped. See column 2, lines 21-24.

Thomas is directed to a refastening fastening device of a hook and loop variety. See column 1,lines 17-20. The fastening system may include a male component including a plurality of hooks and a female component including a plurality of loops. See column 3, lines 28-33. The male portion of the device according to Thomas is referred to as the hook fastening component. See

[4] We note that claim 38 (as well as claim 21) does not specify a hook or loop. Hence, appellants' argument regarding a distinction between

column 4, lines 46-47. The female portion 20 includes a plurality of free formed loop components. See column 4, lines 65-66.

In view of the fact that Shepard teaches that it is known in the art that hook components may be hook or mushroom shaped, we agree with the examiner that it was within the skill of one of ordinary skill in the art to make a hook or mushroom shaped fastener.[5]

In view of the above, we affirm the U.S.C. § 103 rejection of claim 38 as being obvious over Thomas in view of Shepard.

IV. The 35 U.S.C. § 103 rejection of claims 32, 41 and 54 as obvious over Wessels in view Murasaki

Beginning on page 18 of the brief, appellants argue that claims 32, 41 and 54 are not prima facie obvious over Wessels in view of Murasaki because the references do not suggest the aspect of the claims regarding polymeric regions fused to a first major side of the web. We are not convinced by this argument for the same reasons discussed supra, regarding this claim limitation.

Beginning on page 19 of the brief, appellants argue that claims 21 and 54 are not obvious over Wessels in view of Murasaki. Appellants argue that claims 41 and 48 recite an

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a hook or loop is not convincing.

[5] In this regard, we refer to the bottom of page 6 of appellants' specification, wherein appellants admit that U.S. Patent No. 5,077,870 discloses forming hooks in stems by capping the stems to form mushroom

elastic web.[6] Appellants argue that Wessels and Murasaki do not teach an elastic web. We are not convinced by this argument for the same reasons discussed supra, regarding this claim limitation.

In view of the above, we affirm the 35 U.S.C. § 103 rejection of claims 32, 41 and 54 under as being obvious over Wessels in view Murasaki.

V. The 35 U.S.C. § 103 rejection of claims 34-37 as being obvious over Wessels

Beginning on page 20 of the brief, appellants argue that Wessels does not suggest every element of claim 21 (the polymeric region being fused to a first major side of the web). We are not convinced by this argument for the same reasons discussed supra, regarding this limitation. Hence, we affirm the 35 U.S.C. § 103 rejection of claims 34-37 as being obvious over Wessels.

[6] We note that claim 54 does not recite an elastic web, but that claim 54 depends upon claim 48 which does recite an elastic web. Likewise, claim 41 does not recite an elastic web, but does depend upon claim 40 which does recite an elastic web.

VI. The 35 U.S.C. § 103 rejection of claims 40, 42-48, 50-53, 55, 56, and 58-70, as being obvious over Wessels in view of Allen

Beginning on page 21 of the brief, appellants argue that Wessels does not teach the aspect of claims 40 and 48 wherein the polymeric regions are fused to a first major side of the web. Appellants also argue that the same argument applies equally to independent claim 56, and its dependent claims 58-70. Brief, pages 21-22. We are not convinced by this argument for the reasons discussed, supra, regarding the anticipation rejection over Wessels.

Beginning on page 22 of the brief, appellants argue that claim 56 also recites that the polymer of the at least one discrete polymeric region is entangled with a fibrous surface of the nonwoven web. Appellants argue that the examiner has not identified such a teaching in either Wessels or Allen.

In response, beginning on page 11 of the answer, the examiner states that Wessels discloses a mechanical fastener for use in diapers (column 2, line 4), formed from a web construction comprising a substrate sheet (web) of a coarse woven or knit (elastic) structure having pores large enough to pass molten resin material throughout its entire area, and the hook and loop elements existing mixedly on the one surface of the substrate sheet as a plurality of strips, and refers to Fig. 4E and column

3, lines 24-37 of Wessels. On page 12 of the answer, the examiner also states that Wessels discloses a molded fastener wherein a synthetic resin encapsulates the substrate, as shown in Figs 4A-4F. The examiner's position is that this results in a polymer melt entangled with a fibrous surface of the web. We agree.

Beginning on page 23 of the brief, appellants argue that replacing Wessels' polymeric web with the nonwoven fibrous web of Allen is not a proper combination because there is no reasonable expectation of success. Appellants argue that Wessels describes the need for the polymeric material of the hooks to encapsulate the substrate. Appellants argue that in contrast, the elastomeric backings of Allen are generally described as films, with no specific need for openings that would allow encapsulation as discussed in connection with Wessels. As a result, appellants submit that the asserted modification of Wessels using the substrate of Allen would not reasonably be expected to form a successful product.

In response, on page 12 of the answer, the examiner states that Allen teaches that a composite female component of the fastening device for the use in diapers comprising a non-woven fibrous web joined to an elastic backing, provides a low cost loop fastening material, instead of conventional <u>knit or woven</u> fabric. The examiner relies upon this teaching for the

motivation to combine with Wessels.

We note that the prior art can be modified or combined to reject claims as prima facie obvious as long as the references, taken as a whole, would have suggested the claimed invention to one of ordinary skill in the art, and one of ordinary skill in the art would have had a reasonable expectation of success in making the combination. In re Merck & Co., Inc., 800 F.2d 1091, 1097, 231 USPQ 375, 379 (Fed. Cir. 1986). In the instant case, the examiner has carefully explained the motivation provided by Allen for making the combination with Wessels. Also, one skilled in the art, given the teaching found in Allen, would expect a likelihood of success in substituting a knit or woven fabric with a non-woven fibrous web.

In view of the above, we affirm the 35 U.S.C. § 103 rejection of claims 40, 42-48, 50-53, 55, and 56-70, as being obvious over Wessels in view of Allen.

VII. Conclusion

Each of the rejections is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR §1.136(a).

AFFIRMED

Terry J. Owens TERRY J. OWENS Administrative Patent Judge	
Thomas A. Waltz THOMAS A. WALTZ Administrative Patent Judge	BOARD OF PATENT APPEALS AND INTERFERENCES
Beverly A. Franklin BEVERLY A. FRANKLIN Administrative Patent Judge	

BAF/vsh

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APPENDIX
Claims 21, 40, 48, 56

21. A web construction comprising:.

a web coextensive with the web construction, wherein the web comprises two opposing sides and an indefinite length;

a plurality of discrete polymeric regions fused, to a first major side of the web; and

a plurality of stems extending from each discrete polymeric region of the plurality of polymeric regions.

40. A web construction comprising:

an elastic web coextensive with the web construction;

a plurality of discrete polymeric regions fused to a first major side of the web; and

a plurality of stems extending from each discrete polymeric region of the plurality of polymeric regions, wherein the web defines a localized plane, and wherein the plurality of stems is oriented at an angle that is not normal to the localized plane.

48. A web construction comprising:

an elastic web comprising loop structures, wherein the elastic web is coextensive with the web construction;

a plurality of discrete polymeric regions fused to a first major side of the web; and

a plurality of stems extending from each discrete polymeric region of the plurality of polymeric regions, wherein the plurality of stems is adapted to lock with the loop structures of the web.

56. A mechanical fastener comprising:

a nonwoven web with at least one discrete polymeric region fused to a first major side of the nonwoven web such that polymer of the at least one discrete polymeric region is entangled with a fibrous surface of the nonwoven web; and

a plurality of stems extending from the at least one discrete polymeric region.

DESIGN TOOLS
Design Guide

Thermoplastic Resins

Selection and Performance

This chapter contains summary performance data that will be helpful in making or confirming your initial polymer selection.

The Property Comparisons of Selected Engineering Thermoplastics (76KB PDF) table compares selected properties of a number of widely used thermoplastics. The data are useful in making preliminary evaluations of thermoplastic materials.

Designers can choose to specify thermoplastic materials for various components, and often this can result in commercially successful products, superior to similar components in other materials.

The correct and easy selection of suitable components for manufacture in thermoplastics, and the choice of the correct material for each component, obviously needs the designer's awareness of the performance properties and attributes of thermoplastic materials, and how these properties can be used in solving many design problems.

This can involve knowledge of one or more of the following:

- Fabrication techniques such as injection molding, structural foam molding, gas-assisted injection molding, co-injection molding, blow molding, sheet extrusion, and thermoforming – together with any constraints inherent in the method, due to shape, size and cost control.
- Assembly methods such as snap-fitting, solvent bonding, ultrasonic and thermal welding, riveting and screw fastening – and how these can affect component design.
- The dimensional stability of the materials together with any influence on probable service life in normal and severe environments.
- Food contact regulations and flammability standards. These can help determine the suitability of designs for selected packaging, construction and other uses.
- Hydrolytic stability and sterilizability (using steam, ethylene oxide or radiation techniques) in order to ensure suitability in many household, industrial and medical applications.
- How ultraviolet stability affects the design in both exterior and interior applications.
- How finishing techniques can affect the suitability of the materials for a number of uses.

Knowledge of these and other performance attributes affect not only shape and functional suitability, but often also the economic role of thermoplastics in a given design or component.

Some of these attributes are described in detail in this design manual. Others are briefly mentioned. However, if you require further details, Contact Us or call +60-3-7958-3392.

The other chapters in this manual provide basic data, design principles and formulas. These will help designers and engineers to make well-informed judgments regarding the use of engineering thermoplastics.

The selection of a particular resin can be influenced by many things: strength, stiffness, electrical and physical characteristics among others. Here are a few examples:

- **Elasticity** – If your product requires a fair degree of flexibility, you have a good choice from polyethylene, vinyls, polypropylene, acetal and nylon. You can also use some of the more rigid plastics so long as the section is correctly designed. For more information, see Viscoelastic Properties.
- **Ignition resistance** – In many electronic applications such as enclosures or connectors, plastic components must demonstrate ignition resistance. Standards such as Underwriters Laboratory 94 spell out specific ignition-resistant test protocols. Certain grades of polycarbonate, PC/ABS, ABS, nylon, and polysulfone are suitable. See Thermal Properties for other details to consider.
- **Gears and bearings** – Highly stressed gears can be produced in nylon and acetal especially when reinforced with glass fillings. Other useful reinforcements include graphite and molybdenum disulphide. Acetal resin is good for small, precisely dimensioned gears.
- **Impact resistance** – Polycarbonate, ABS and polyphenylene oxide (in its impact-modified form) have good impact characteristics. See Impact Strength for more information.
- **Odor and taste** – These will be of concern to you if you design for the food industries, either in packaging or in food processing machinery. Polystyrene, polyethylene, ABS, acrylic and polysulfone are among the satisfactory resins for such uses.
- **Surface wear** – Scratch resistance does not necessarily equate with hardness. Acrylic, ABS and SAN resins generally have good resistance against scratches due to handling.
- **Temperature** – Some materials will be eliminated from your choice because of thermal restrictions. For products operating above about 250ºC (482ºF), the silicones, polyimides, hydrocarbon resins or mica may be required. At the other extreme, polyphenylene oxide can be used at temperatures as low as -180ºC (-292ºF). Refer to Thermal Properties for other guidance.

Download Property Comparisons of Selected Engineering Thermoplastics (76KB PDF)

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